JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1998, **31,** 543–560 NUMBER 4 (WINTER 1998)

ESTABLISHING DISCRIMINATIVE CONTROL OF RESPONDING USING FUNCTIONAL AND ALTERNATIVE REINFORCERS DURING FUNCTIONAL COMMUNICATION TRAINING

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Functional communication training (FCT) is a popular treatment for problem behaviors, but its effectiveness may be compromised when the client emits the target communication response and reinforcement is either delayed or denied. In the current investigation, we trained 2 individuals to emit different communication responses to request (a) the reinforcer for destructive behavior in a given situation (e.g., contingent attention in the attention condition of a functional analysis) and (b) an alternative reinforcer (e.g., toys in the attention condition of a functional analysis). Next, we taught the participants to request each reinforcer in the presence of a different discriminative stimulus (S^D). Then, we evaluated the effects of differential reinforcement of communication (DRC) using the functional and alternative reinforcers and correlated S^Ds, with and without extinction of destructive behavior. During all applications, DRC (in combination with S^Ds that signaled available reinforcers) rapidly reduced destructive behavior to low levels regardless of whether the functional reinforcer or an alternative reinforcer was available or whether reinforcement for destructive behavior was discontinued (i.e., extinction).

DESCRIPTORS: autism, developmental disabilities, discriminative stimulus, functional analysis, functional communication training, reinforcer substitutability, stimulus control

Functional communication training (FCT) is a treatment commonly prescribed when a functional analysis has shown that an individual's problem behavior is maintained by social consequences (e.g., Carr & Durand, 1985; Fisher et al., 1993; Horner, Day, Sprague, O'Brien, & Heathfield, 1991; Lalli, Casey, & Kates, 1995; Wacker et al., 1990). With FCT, the individual is taught a communicative response that produces access to the reinforcer responsible for maintenance of the problem behavior. For example, an individual whose problem behavior is maintained by escape from tasks might be taught to request a break by signing "finished" (e.g., Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998). Thus, FCT is a specific type of a differential reinforcement of alternative behavior (DRA) schedule, and it is generally combined with other operant procedures, such as extinction or punishment (Fisher et al., 1993; Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Hagopian et al., 1998; Kahng, Iwata, DeLeon, & Worsdell, 1997; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Wacker et al., 1990).

Although it can be classified as a DRA schedule, FCT is somewhat unique in that, by design, the alternative response (a) specifies its reinforcer (i.e., a mand specifying the reinforcer that previously maintained problem behavior), (b) requires minimal response effort, (c) is reinforced on a dense schedule (usually a fixed-ratio [FR] 1), and (d) can be

This investigation was supported in part by Grant MCJ249149-02 from the Maternal and Child Health Service of the U.S. Department of Health and Human Services. We express our appreciation to Steve Lindauer for his excellent clinical work on one of the cases presented in this paper.

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used to obtain reinforcement across environmental contexts. Because of the ease and consistency with which reinforcement can be obtained during FCT, some authors have suggested that the client "controls" the delivery of reinforcement with this treatment (e.g., Carr & Durand, 1985; Wacker et al., 1990). Early on, Carr and Durand suggested that this characteristic, "control over reinforcement," contributed to the effectiveness of FCT, and a preliminary investigation of this variable lent some support to their assertion (Wacker et al., 1990). However, two recent investigations found that noncontingent reinforcement (NCR), which does *not* allow the client to control the schedule of reinforcement, and FCT, which does, produced equivalent reductions in problem behavior (Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Kahng et al., 1997).

Although control over reinforcement may not influence treatment efficacy, it may affect client preferences for one treatment over another. Hanley, Piazza, Fisher, Contrucci, and Maglieri (1997) found that both of their participants showed a clear preference for FCT over NCR when they were allowed to choose between the two treatments in a concurrent-chains arrangement. Other potential benefits of teaching a client to recruit reinforcement through FCT are that treatment effects may more readily be maintained and generalize, because the communication response may prompt both trained and untrained caregivers to deliver differential reinforcement appropriately (e.g., Durand & Carr, 1991).

Although there are clear benefits to teaching individuals with problem behavior to easily recruit differential reinforcement across settings via FCT, there are also a number of potential drawbacks. First, individuals may display the response at exceedingly high rates, making it difficult for caregivers to provide reinforcement for each communicative response (e.g., requesting a break from every task presented at school). For example, recent studies have reported communication rates of one per minute or higher for most clients (Hagopian et al., 1998; Shirley et al., 1997). It would be difficult for most caregivers to consistently reinforce communication at such high rates. Second, individuals may request reinforcement at times when it is impossible or inconvenient to deliver (e.g., when a caregiver is tending to the needs of an infant sibling). In these situations, reinforcement may be delayed (e.g., until the caregiver's attention is available) or denied altogether. If reinforcement of communication is frequently delayed or denied, this response may be weakened and destructive behavior may reemerge (Fisher, Thompson, Bowman, Hagopian, & Krug, in press). Consistent with this supposition, Hagopian et al. (1998) found that the effectiveness of FCT in combination with extinction often decreased markedly when the schedule of reinforcement for communication was thinned (either through fading the rate of reinforcement or introducing reinforcement delays of increasing length). Thus, procedures are needed to increase the effectiveness of FCT in situations in which it is impractical or impossible to deliver a given reinforcer.

Fisher et al. (in press) applied techniques to teach participants to tolerate delayed or denied reinforcement during FCT that were similar to procedures used in research on self-control. In the self-control literature, individuals are given a choice between a smaller, more immediate reinforcer (i.e., the impulsive option) and a larger, more delayed reinforcer (i.e., the self-control option). Choosing the self-control option generally produces a better payoff over the long run (see Fisher & Mazur, 1997, for a discussion). Several techniques have been developed to teach individuals to choose the self-control option and receive the better payoff, which Fisher et al. (in press) adapted to FCT.

The first method used by Fisher et al. (in

press), delay fading, involved instituting a short delay to reinforcement for FCT and then gradually increasing the length of the delay over time (e.g., Mazur & Logue, 1978; Schweitzer & Sulzer-Azaroff, 1988). In a second case, Fisher et al. provided an alternative activity during periods when reinforcement for communication was not available (e.g., Grosch & Neuringer, 1981; Mischel, Ebbesen, & Zeiss, 1972). In a third case, a punishment procedure was used to decrease destructive behavior when reinforcement was not immediately available (cf. Flora, 1995; Ross, 1974). Each of these three techniques was successful in teaching the participants in the Fisher et al. study to tolerate periods of up to 10 min during which reinforcement for communication was unavailable. However, there may be situations in which a given type of reinforcement may be unavailable for more extended periods (e.g., caregivers may run out of the client's preferred food). In addition, there may be situations in which the availability of reinforcement may change from one moment to the next (e.g., a teacher's attention may be available only when it is not directed toward another student). In these situations, alternative procedures may be needed to teach clients to tolerate the unavailability of a given reinforcer.

Another technique that may lessen the potential negative effects of delayed or denied reinforcement during FCT is to correlate either the availability or unavailability of reinforcement with a signal (e.g., tone, colored light). Signaled reinforcement delays generally maintain higher levels of responding than do unsignaled delays of the same length (Lattal, 1984; Richards, 1981; Schaal & Branch, 1990). The efficacy of this technique might be enhanced if a stimulus that signaled the unavailability of one reinforcer (e.g., attention) also signaled the availability of an alternative reinforcer (e.g., toys). Two recent investigations have shown that noncontingent presentation of alternative or substitute reinforcers (e.g., toys, food) can reduce destructive behavior maintained by attention (Fischer, Iwata, & Mazaleski, 1997; Hanley, Piazza, & Fisher, 1997). The use of alternative or substitute reinforcers during FCT might similarly facilitate reductions in destructive behavior, especially if the availability of each reinforcer was signaled by a discriminative stimulus (S^D). Correlating different reinforcers (e.g., attention, toys) with unique FCT responses and discriminative stimuli would allow caregivers to make one reinforcer available (e.g., attention) when another one was not (e.g., when a sibling had a preferred toy). It would also signal which reinforcers were available at any given time.

As mentioned previously, an FCT response may be weakened if it is emitted often when reinforcement is unavailable or significantly delayed. For example, communication decreased to near-zero levels for 1 participant in the Fisher et al. (in press) study when reinforcement was delayed for just 30 s. Thus, another potential advantage of signaling the availability or unavailability of reinforcement for FCT responses is that these responses should occur at high levels when reinforcement is available and at low levels at other times.

In this study, we used two techniques to enhance the effectiveness of FCT plus EXT when the reinforcer responsible for maintenance of destructive behavior in a given situation was not available for communication. First, we identified alternative reinforcers for each participant. For 1 participant with multiply controlled destructive behavior, the alternative reinforcer was one that maintained the behavior in another functional analysis condition (i.e., toys were used as alternative reinforcement in the attention condition and attention was used as alternative reinforcement in the tangible condition). For the other participant, the alternative reinforcer (ac-

cess to toys) was identified through a preference assessment (Fisher et al., 1992) and, by history, did not appear to be related to the maintenance of destructive behavior. Next, we conducted discrimination training with the participants to bring each communication response under the control of a different S^D. We then evaluated the effectiveness of differential reinforcement of communication (DRC) when the availability of each reinforcer (attention and toys) was signaled by the discriminative stimuli. Finally, we conducted a component analysis to determine the independent effects of DRC and extinction (i.e., discontinuation of reinforcement for destructive behavior).

GENERAL METHOD

Participants and Setting

Two clients admitted to an inpatient unit specializing in the treatment of severe behavior disorders participated in this investigation. Amy was a 13-year-old girl who had been diagnosed with mild mental retardation and a seizure disorder. Amy displayed academic skills at approximately a third-grade level and spoke in simple, short sentences. Ned was a 9-year-old boy who had been diagnosed with autism, attention deficit hyperactivity disorder, and moderate mental retardation. Ned had a sign vocabulary of approximately 15 words but did not use any spoken words consistently. He could follow two-step directions.

Data Collection and Interobserver Agreement

Amy's targeted behaviors were self-injury (head banging, self-scratching, self-biting, hair pulling), aggression (hitting, kicking, scratching, pinching, throwing objects at others), and property destruction (swiping objects off a table, breaking or ripping objects). Her communication responses were the verbal response "Excuse me please," which resulted in access to adult attention, and "I want my toys please," which resulted in access to preferred items. Ned's destructive behaviors were aggression (biting, hitting, kicking, scratching, pinching) and property destruction (banging on walls or windows, kicking objects, slamming doors, breaking or ripping objects). His appropriate communication responses were (a) a manual sign for hugs (crossing the arms in front of the body in a hugging motion), which resulted in physical attention, and (b) a manual sign for games (making a fist with both hands with thumbs extended and touching the knuckles together), which resulted in access to preferred toys. For both clients, communication responses were scored as correct communication if they were emitted in the presence of the corresponding S^D and as incorrect communication if they were emitted in the absence of that stimulus.

Trained observers recorded the frequency of targeted behaviors on laptop computers. All sessions were 10 min in length and were partitioned into 60 intervals (10 s each) to calculate interobserver agreement. Exact agreement coefficients were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. An agreement was defined as both observers recording the same frequency of a target response in a given 10-s interval. Reliability was assessed during at least 43% of sessions during each assessment and treatment evaluation conducted with each participant (range, 43.5% to 76.1%). For each target response displayed by each participant in every assessment or treatment evaluation, the mean exact agreement coefficient exceeded 87% (range, 87.8% to 100%).

Phase 1: Functional Analyses and Descriptive Assessments

In addition to the current study, Amy and Ned participated in an ongoing larger investigation on the benefits of integrating de-

scriptive information with functional analyses. This larger study involved a series of complex assessment phases that led ultimately to clear functional analysis outcomes for most participants, including Amy and Ned. As a result, the details of the functional assessment conducted with the current participants extend beyond the scope of this study. It is worth noting, however, that in the final phases of their assessments, it was shown that Amy's destructive behavior was maintained by attention and by toys, and Ned's was maintained by attention. Only the procedures and results for these final phases are described below.

Procedure

For both clients, modified experimental analyses were conducted to test the hypotheses generated by the results of the descriptive assessments. In these analyses, two experimental conditions were compared in each phase using a multielement design (Iwata et al., 1994). For Amy, two two-phase analyses employing multielement designs were conducted. These analyses were designed to determine whether her destructive behavior was multiply maintained by both attention and access to tangible items, but under specific stimulus conditions (e.g., when the caregiver's attention was diverted to another individual). In the first analysis, there were three conditions: (a) attention, (b) diverted attention, and (c) noncontingent attention. The attention condition was similar to the one described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). In the attention condition, a single therapist sat in a chair and read a magazine while Amy was expected to play quietly with toys. The therapist delivered a verbal reprimand to Amy contingent on destructive behavior on an FR 1 schedule, and all other behaviors were ignored. The diverted attention condition was identical to the attention condition except that two therapists were in the room interacting with one another and one of them delivered a verbal reprimand to Amy contingent on destructive behavior on an FR 1 schedule, and all other behaviors were ignored. In the noncontingent attention condition, both therapists interacted with Amy throughout the session (e.g., they colored together), and all destructive responses were ignored.

The second analysis conducted with Amy was designed to test the hypothesis that her destructive behavior was maintained by access to tangible reinforcement (toys), but specifically when another individual was playing with the toys. In this analysis, there were three conditions: (a) tangible, (b) diverted tangible, and (c) noncontingent tangible. Prior to the tangible condition, Amy was allowed 2 min of access to preferred items (i.e., crayons, keyboard). The items were removed at the start of the session and returned to Amy for 30 s contingent on destructive behavior on an FR 1 schedule. All other responses were ignored. The diverted tangible condition was identical to the tangible condition except that the therapist played with the toys when they were removed from Amy (to mimic what occurred when Amy was asked to share with siblings). In the noncontingent tangible condition, Amy was allowed to interact with the toys throughout the sessions, and all of her responses were ignored by the therapist. In the second phase, the diverted tangible condition was compared with the tangible condition from the first functional analysis.

For Ned, an analysis was conducted to test the hypothesis that his destructive behavior was maintained by a somewhat unique form of attention (i.e., the combination of a verbal reprimand and brief physical restraint). During this analysis, a test condition, reprimand plus restraint, and a control condition, noncontingent attention, were compared using a multielement design. The reprimand plus restraint condition was

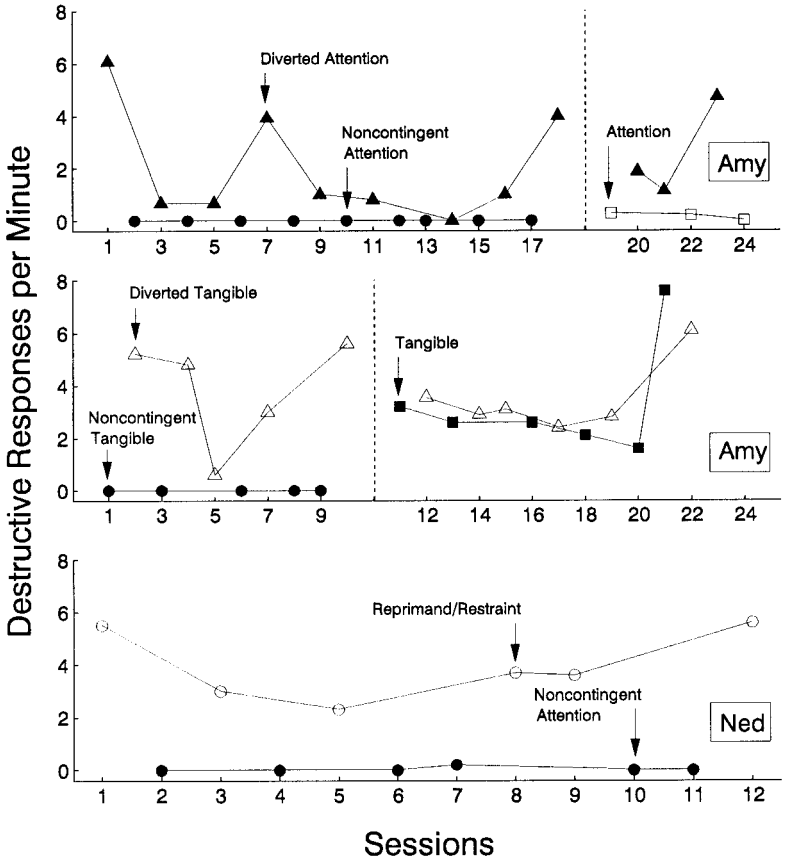

Figure 1. Rates of destructive behavior during the test and control conditions of the modified functional analyses conducted with Amy (top and middle panels) and Ned (bottom panel).

identical to the attention condition described above for Amy except that destructive behavior resulted in a brief verbal reprimand (e.g., "Don't do that, you'll hurt me") and brief restraint (e.g., his hands were held by his side for 5 s) on an FR 1 schedule. During noncontingent attention, nearly continuous verbal and physical interaction were provided (e.g., the therapist tickled and hugged Ned), and no consequence was delivered for destructive behavior.

Results and Discussion

The results of the modified functional analysis conducted with Amy are depicted in the top and middle panels of Figure 1. Amy displayed relatively high rates of destructive behavior in the diverted attention condition (M = 2.2; range, 0 to 6.1) but displayed low rates in the noncontingent attention condition (M = 0) and the attention condition (M = 0.2; range, 0 to 0.3). These results clearly supported the hypothesis that Amy's destructive behavior was maintained by contingent attention, specifically when the caregiver's attention was diverted to another individual. By contrast, Amy displayed high rates of destructive behavior both in the diverted tangible condition (M = 3.6; range, 0.6 to 6.1) and in the tangible condition (M = 3.3; range, 1.6 to 7.6), but no destructive behavior occurred in the noncontingent tangible condition. These findings indicate that tangible reinforcement maintained destructive behavior, but this functional relation was not specific to antecedent conditions in

which another individual played with the toys.

The results of the modified functional analysis conducted with Ned are depicted in the bottom panel of Figure 1. Ned displayed high rates of destructive behavior in the reprimand plus restraint condition ($M = 4.0$; range, 2.3 to 5.6), but displayed near-zero rates in the noncontingent attention condition ($M = 0.03$; range, 0 to 0.2). These results supported the hypothesis that Ned's destructive behavior was maintained by contingent attention consisting of a verbal reprimand in combination with brief physical restraint.

The results of the modified functional analyses conducted with Amy suggested that both attention and toys were effective reinforcers (because they both maintained destructive behavior). Therefore, we hypothesized that access to toys might be an effective alternative (or substitute) reinforcer in antecedent situations that typically evoked attention-maintained destructive behavior (i.e., when a caregiver's attention was diverted to another individual). Similarly, attention might be an effective alternative reinforcer in antecedent conditions that typically evoked destructive behavior maintained by tangible items (i.e., when access to toys was restricted).

The results of the modified functional analysis conducted with Ned indicated that his destructive behavior was maintained by verbal and physical attention, but no potential alternative reinforcers were suggested from the functional analyses and descriptive assessments. Therefore, a choice assessment, using the methods described by Fisher et al. (1992), was conducted to identify Ned's five most preferred toys from an array of 15 tangible items. His five most preferred toys were a wire wisk, a wrench, a musical book, a ridged ball, and a play phone. These five items were subsequently used as alternative reinforcers in Phases 2 and 3.

Phase 2: Communication and Discrimination Training

Communication Training

During communication training, the 2 clients were taught to emit one communicative response to obtain attention and another to obtain toys. Training ended when the participant displayed the target communication response during 80% of trials during two consecutive 10-trial sessions (which took two sessions for Amy and seven for Ned). For Amy, only verbal instruction was required to teach her the phrases "Excuse me please" to produce 30 s of attention and "I want my toys please" to produce 30 s of access to toys. For Ned, therapists used sequential verbal, gestural, and physical prompts to teach him to sign "hugs" to produce attention for 30 s and "games" to produce access to toys for 30 s. Attempts during training to engage in destructive behavior (which rarely occurred) were blocked and the prompting sequence was continued.

Initial Discrimination Training (Amy and Ned)

After communication training was completed, discrimination training was conducted to teach the clients to emit the target communication responses only when reinforcement was available (i.e., when the corresponding S^D was present). Stimuli used during discrimination training for Ned were two colored drawings (15.3 cm by 21.6 cm); one indicated that toys were available (a drawing of a boy with toys) and one indicated that physical and verbal interactions with adults were available (a drawing of a boy on an adult's shoulders). Stimuli used for Amy were a picture (11.4 cm by 16.6 cm) of preferred toys to indicate that toys were available and a picture of Amy interacting with the therapist to indicate that attention was available.

At the start of each discrimination train-

ing session, the appropriate stimulus was hung on the wall for 30 s (stimulus present). After 30 s, the stimulus was removed from the wall and placed out of view (stimulus absent). These stimulus-present and stimulus-absent periods were alternated every 30 s for the duration of the 10-min session. When a given S^D was present (the picture of toys), emission of the correct communication response ("I want my toys please") resulted in 30 s of access to the corresponding reinforcer (toys) on an FR 1 schedule. When the S^D was absent, communication produced no consequence (i.e., extinction). All destructive responses and nontargeted communicative responses were ignored. Discrimination training ended for each client when high and stable rates of the communication response occurred in the presence of the corresponding S^D and near-zero rates occurred in its absence. For Amy, communication for tangible reinforcement ("I want my toys please") and attention ("Excuse me please") was brought under stimulus control in seven sessions and six sessions, respectively. For Ned, communication for toys (signing "games") was brought under stimulus control in 14 sessions.

Additional Discrimination Training (Ned Only)

During the initial discrimination training for attention (signing "hugs" in the presence of the corresponding S^D), Ned's rates of communication were inconsistent, and he had few opportunities to learn the contingencies in effect. We hypothesized that extinction, which was in place when the S^D was absent, was lowering the rate of communication, even when the S^D was present (i.e., carryover effects). Therefore, after seven sessions, the training procedures were modified so that there was always an S^D present (i.e., we alternated three reinforcement conditions rather than one reinforcement condition and an extinction condition). The modified sessions were identical to those previously described except that three S^Ds were used, and each one was correlated with a different communication response and corresponding form of reinforcement. The three S^Ds were the pictures for attention and toys (described above) and another one showing a boy running. This third S^D and corresponding reinforcer were included to replace the extinction condition (i.e., no S^D present and no reinforcement available). This third reinforcer was identified and included based on the observation that Ned frequently ran around when this response was not prevented (staff members frequently held his hand to prevent him from running).

The three correct communication responses were signing "hugs" in the presence of the picture for attention, signing "games" in the presence of the picture for toys, and signing "run" in the presence of the picture of a boy running. The three corresponding reinforcers were attention, toys, and being able to run around, respectively. All reinforcers were delivered for 30 s. One S^D at a time was presented for 1 min. The order of the first three S^D presentations in a given session was randomized, without replacement; thereafter, the order remained constant. Using this modified procedure, communication for toys, attention, and running was brought under stimulus control in 19 sessions.

Phase 3: Treatment Evaluation of FCT with Discriminative Stimuli

Procedure

Following the completion of communication training and discrimination training, we evaluated the effectiveness of two treatments that combined differential reinforcement of communication with extinction. In both treatments, the contingency maintaining destructive behavior was discontinued (i.e., extinction). The two treatments dif-

fered in terms of the S^D present, the target communication response, and the reinforcer delivered for communication.

The baseline conditions for Amy were the diverted attention condition from the modified functional analysis described in Phase 1 (henceforth referred to as the attention condition) and the tangible condition (also described in Phase 1). The baseline condition for Ned was the reprimand plus restraint condition from the modified functional analysis (henceforth referred to as the attention condition).

During FCT, the S^D, target communication response, and reinforcer all corresponded to the reinforcement that previously maintained problem behavior in a given condition. For Amy, contingent attention maintained problem behavior in the attention condition, and contingent access to toys maintained problem behavior in the tangible condition. Therefore, for Amy, there were two versions of FCT, one that was implemented in the attention condition—FCT (att)—and one that was implemented in the tangible condition—FCT (toys). During FCT (att), the S^D for attention (picture of Amy and a therapist interacting) was present, and saying "Excuse me please" produced 30 s of attention from the therapist. During FCT (toys), the S^D for tangible reinforcement (picture of preferred toys) was present, and saying "I want my toys please" produced the toys for 30 s. There was no programmed consequence for destructive behavior in either FCT treatment (i.e., extinction).

For Ned, problem behavior was maintained by contingent attention in the attention condition. Therefore, during FCT (att) for Ned, the S^D for attention (picture of a boy on an adult's shoulders) was present, and signing "hugs" produced verbal and physical interaction for 30 s. There was no programmed consequence for destructive behavior (i.e., extinction).

During alternative communication training (ACT), the S^D, target communication response, and reinforcer did *not* correspond to the reinforcement that had previously maintained problem behavior in a given condition (e.g., toys were available for communication in the attention condition and access to attention was restricted throughout the session). For Amy, there were two versions of ACT, one that was implemented in the attention condition—ACT (toys)—and one that was implemented in the tangible condition—ACT (att). During ACT (toys), which was conducted in the attention condition, the S^D for tangible reinforcement (picture of preferred toys) was present, and saying "I want my toys please" produced preferred toys for 30 s. Attention was unavailable throughout the session (i.e., two therapists interacted with each other). During ACT (att), which was implemented in the tangible condition, the S^D for attention (picture of Amy and a therapist interacting) was present, and saying "Excuse me please" produced attention for 30 s. After the toys were removed at the start of the session, they remained in view but were unavailable for the remainder of the session. During both ACT treatments, there was no programmed consequence for destructive behavior (i.e., extinction).

For Ned, problem behavior was maintained by contingent attention in the attention condition. Therefore, during ACT (toys), the S^D for toys (drawing of a boy with toys) was present, and signing "games" produced access to preferred toys for 30 s. Attention was unavailable throughout the session (i.e., the therapist sat in a chair and read a magazine). There was no programmed consequence for destructive behavior (i.e., extinction). Table 1 provides a summary of the S^Ds, target communications, and reinforcers in the various FCT and ACT interventions.

Table 1
Summary of Functional Communication Training (FCT) and Alternative Communication Training (ACT)

Participant	Condition	Treatment	Discriminative stimulus	Target communication	Reinforcer
Amy	Attention	FCT (attention)	Photo of Amy with adult	"Excuse me please."	Attention
	Attention	ACT (toys)	Photo of preferred toys	"I want my toys please."	Toys
	Tangible	FCT (toys)	Photo of preferred toys	"I want my toys please."	Toys
	Tangible	ACT attention)	Photo of Amy with adult	"Excuse me please."	Attention
Ned	Attention	FCT (attention)	Drawing of Ned with adult	Sign for "hugs"	Attention
	Attention	ACT (toys)	Drawing of Ned with toys	Sign for "games"	Toys

Results and Discussion

The top panel of Figure 2 show the rates of destructive behavior emitted by Amy in the attention condition during baseline, FCT (att), and ACT (toys). In the attention baseline, rates of destructive behavior were high but variable ($M = 1.6$; range, 0 to 4.2). Both FCT (att) and ACT (toys) reduced destructive behavior in the attention condition to near-zero levels; M for FCT (att) = 0.02; range, 0 to 0.2; M for ACT (toys) = 0.1; range, 0 to 0.4.

The second panel of Figure 2 shows the rates of correct and incorrect communication emitted by Amy during FCT (att) and ACT (toys). Recall that a communicative response was scored as correct only if it occurred in the presence of the corresponding S^D (e.g., saying "Excuse me please" in the presence of the photo of Amy with an adult). Amy almost exclusively emitted the correct communication response in the attention condition during both FCT (att), when the S^D for attention was present, and during ACT (toys), when the S^D for toys was present.

The third panel of Figure 2 shows the rates of destructive behavior emitted by Amy in the tangible condition during baseline, FCT (toys), and ACT (att). In the tangible baseline, rates of destructive behavior were high and stable ($M = 4.9$; range, 2.4 to 8.8). Both FCT (toys) and ACT (att) reduced destructive behavior in the attention condition to near-zero levels; M for FCT (toys) = 0.02; range, 0 to 0.1; M for ACT (att) = 0.

The fourth panel of Figure 2 shows the rates of correct and incorrect communication emitted by Amy during FCT (toys) and ACT (att). Amy emitted the correct communication response almost exclusively in the tangible condition during both FCT (toys) and ACT (att).

The top panel of Figure 3 shows the rates of destructive behavior emitted by Ned in the attention condition during baseline, FCT (att), and ACT (toys). In the attention baseline, rates of destructive behavior were high and relatively stable ($M = 5.0$; range, 2.6 to 8.1). FCT (att) reduced destructive behavior in the attention condition to near-zero levels during the first treatment phase (i.e., Phase 2; $M = 0.1$; range, 0 to 0.3), but the rates were slightly higher during the second treatment phase ($M = 0.9$; range, 0 to 3.2). ACT (toys) reduced destructive behavior in the attention condition to near-zero levels during both the first and second treatment phases (Ms = 0.2 and 0.1, respectively; both ranges, 0 to 0.5).

The second panel of Figure 3 shows the rates of correct and incorrect communication emitted by Ned during FCT (att) and ACT (toys). Ned emitted the correct communication response exclusively in the attention condition during FCT (att), when the S^D for attention was present, and during ACT (toys), when the S^D for toys was present.

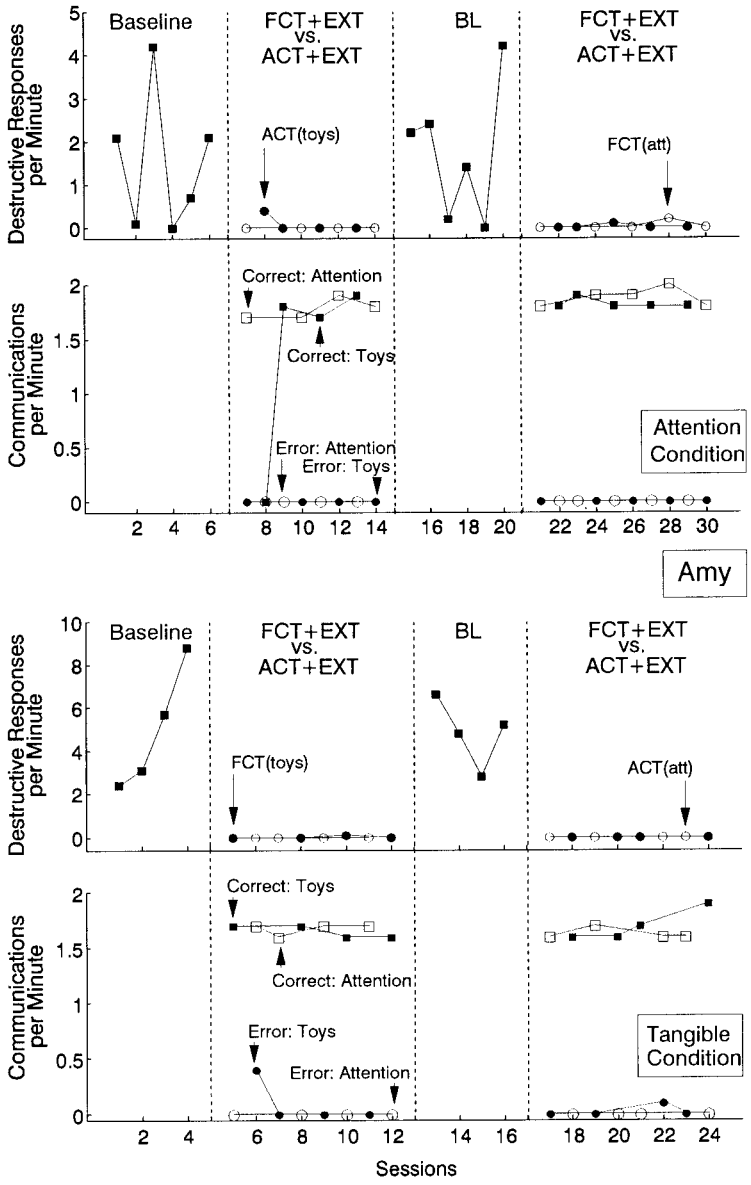

Figure 2. Rates of destructive behavior and correct and incorrect communication emitted by Amy in the attention and tangible conditions during baseline, FCT + EXT, and ACT + EXT.

Phase 4: Independent Effects of FCT and EXT

Although FCT and ACT were equally effective (except during the last phase with Ned, in which ACT was slightly more effective), they were both combined with extinction. Some authors have argued that the reductive effects of FCT result primarily from alterations in the consequences for problem behavior (i.e., changing from reinforcement to either extinction or punishment) rather than from the delivery of reinforcement for communication (Fisher et al., 1993; Hagopian et al., 1998; Kahng et al., 1997; Shirley et al., 1997). If this is true, then the equivalent results produced by FCT and ACT

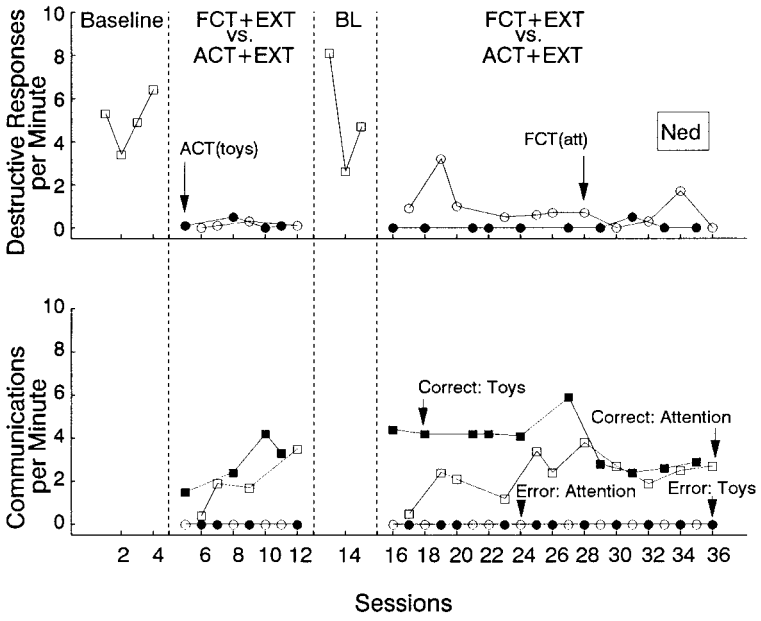

Figure 3. Rates of destructive behavior and correct and incorrect communication emitted by Ned in the attention condition during baseline, FCT + EXT, and ACT + EXT.

may have been due to the fact that both interventions were combined with extinction (i.e., discontinuation of reinforcement for destructive behavior). Therefore, in this phase, we compared the independent effects of differential reinforcement of communication and extinction in the tangible condition with Amy. This analysis was completed with only 1 participant in only one condition because of time limitations on the participants' hospital admissions.

Procedure

The baseline condition was identical to the tangible condition from Amy's modified functional analysis (described in Phase 1). During FCT plus ACT, the S^Ds for attention and tangible reinforcement were alternately present for 1 min each throughout the session. Correct communication (e.g., saying "Excuse me please" in the presence of the S^D for attention or "I want my toys please" in the presence of the S^D for tangible reinforcement) resulted in access to the corresponding reinforcer for 30 s. Destructive behavior continued to produce access to tangible reinforcement (i.e., the toys) for 30 s on an FR 1 schedule, just as in baseline. During extinction alone, neither of the discriminative stimuli (i.e., for toys or attention) was present, and there was no programmed consequence for destructive behavior or communication.

Results

The top panel of Figure 4 shows the rates of destructive behavior emitted by Amy in the tangible condition during baseline, FCT plus ACT, and extinction. Rates of destructive behavior were high and stable during the initial tangible baseline (M = 7.5; range, 5.3 to 9.0) and slightly lower, but on an upward trend, in the second tangible baseline (M = 5.7; range, 4.0 to 6.9). FCT plus ACT reduced destructive behavior to zero each time it was implemented (i.e., each session in both phases). By contrast, the overall level of destructive behavior during extinc-

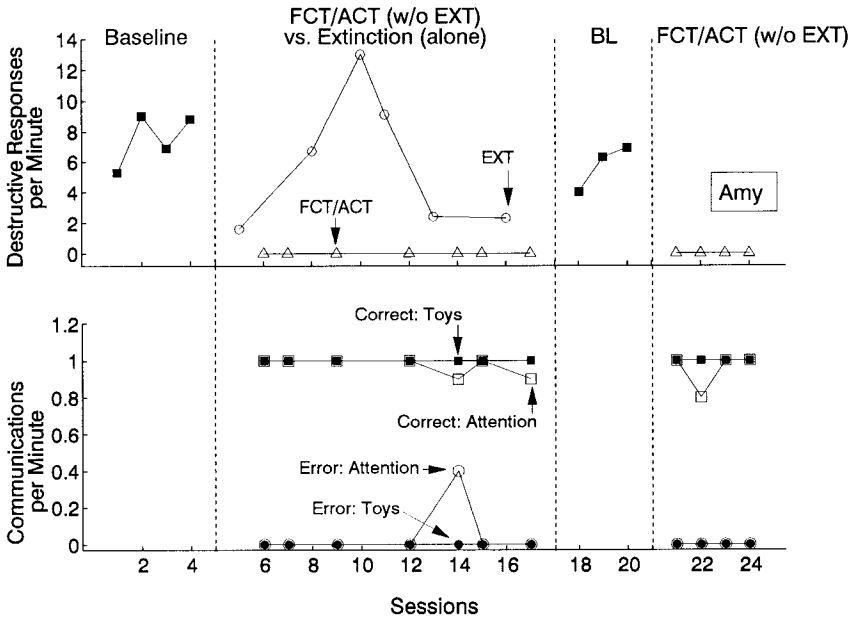

Figure 4. Rates of destructive behavior and correct and incorrect communication emitted by Amy in the tangible condition during baseline, FCT plus ACT, and extinction.

tion alone was only slightly lower than baseline, and the rates were quite variable across the extinction sessions (M = 5.9; range, 1.6 to 13.0). In all likelihood, had the phase been longer, the rates of destructive behavior would have decreased further in the extinction-alone condition.

The bottom panel of Figure 4 shows the rates of correct and incorrect communication emitted by Amy during FCT plus ACT. With the exception of one session (Session 14) in which Amy requested attention in the absence of the corresponding S^D, she emitted the correct communication responses exclusively during FCT plus ACT. These results suggest that the effects of the various FCT and ACT interventions were due to differential reinforcement of communication rather than discontinuation of reinforcement for destructive behavior (i.e., extinction). The results obtained with Amy in Phase 3 also support this conclusion, in that destructive behavior decreased to zero in the first session of each treatment phase (i.e., before destructive behavior contacted extinction).

GENERAL DISCUSSION

Two individuals with severe destructive behavior were taught to obtain attention with one communication response and to obtain tangible reinforcement (toys) with another communication response. Next, these communication responses were brought under stimulus control by delivering the requested reinforcer in the presence, but not in the absence, of a specific discriminative stimulus (a photo or drawing of two people for attention, a photo or drawing of toys for tangible reinforcement). We then evaluated the effectiveness of differential reinforcement of communication in which an S^D signaled that communication would produce (a) the consequence that had previously maintained destructive behavior in a given condition (e.g., attention in the attention condition) or (b) an alternative reinforcer (e.g., toys in the attention condition).

In all FCT and ACT treatment conditions, differential reinforcement of communication reduced destructive behavior to low or near-

zero levels, regardless of whether the reinforcer that had previously maintained destructive behavior was available for communication (i.e., during FCT) or an alternative reinforcer was available (i.e., during ACT). In addition, in each condition, the 2 participants almost exclusively requested the available reinforcer (i.e., the one signaled by the S^D that was present). Thus, the communication responses were under the control of the programmed S^Ds rather than other stimuli unique to a particular condition (e.g., therapist reading a magazine in the attention condition; toys present but unavailable in the tangible condition). Finally, a component analysis was completed with Amy, showing that reductions in problem behavior were due to reinforcement of communication rather than discontinuation of reinforcement for destructive behavior (i.e., extinction).

These results add to the literature on FCT and treatments based on functional analysis in several ways. First, the current results showed that the communication responses associated with both the functional and alternative (or substitute) reinforcers were brought under stimulus control. One important clinical advantage of this procedure is that the client is less likely to request the reinforcer that had previously maintained problem behavior under conditions in which it is inconvenient or impossible for the caregiver to deliver that particular consequence. For example, the S^D for toys could be the only one present when the caregiver is attending to other individuals (e.g., talking on the phone) or tasks (e.g., preparing dinner). The S^D for attention could be the only one present when the toys are unavailable (e.g., because a sibling or classmate has them). Finally, the S^Ds for the functional and alternative stimuli could both (or all) be available at other times, thus giving the client a choice of reinforcers.

With both NCR and FCT plus ACT, caregivers have some degree of choice, because they determine the availability of the various consequences at a given time (Hanley, Piazza, & Fisher, 1997; Shirley et al., 1997). However, one potential advantage FCT plus ACT has over NCR is that the client may choose between multiple available reinforcers. Recall that in the investigation by Hanley, Piazza, Fisher, Contrucci, and Maglieri (1997), both clients preferred FCT to NCR, suggesting that they preferred a condition in which they determined when and if reinforcement was delivered. When one stimulus is available during FCT plus ACT (i.e., only one S^D present), the client determines when and if that reinforcer is delivered. When two or more stimuli are concurrently available, the client determines which reinforcer is delivered and when.

A second contribution of the current study is that these findings replicate and extend those of Fischer et al. (1997) and Hanley, Piazza, and Fisher (1997) by showing that alternative reinforcers can sometimes be substituted when another one is unavailable in a given situation. These two previous investigations showed that noncontingent delivery of tangible reinforcers (toys and food, respectively) produced reductions in attention-maintained problem behavior equivalent to that produced by noncontingent delivery of attention. We produced similar results in the current investigation through contingent delivery of alternative reinforcers during ACT.

For Amy, the alternative (or substitute) reinforcer was one that had been responsible for maintenance of destructive behavior in another condition. That is, attention, which maintained destructive behavior in the attention condition, was used as the alternative reinforcer in the tangible condition. Conversely, access to toys, which maintained destructive behavior in the tangible condition, was used as the alternative reinforcer in the attention condition. In this respect, both attention and toys were "functional" reinforcers, but in different contexts. However, for

Ned, the toys used as the alternative reinforcer were identified via a preference assessment (Fisher et al., 1992), as was the case in the Fischer et al. (1997) and Hanley, Piazza, and Fisher (1997) studies.

A third contribution of the current investigation is that independent effects of extinction and differential reinforcement of communication were isolated. It is commonly held that DRA schedules in general, and FCT in particular, attenuate or eliminate extinction bursts because the individual continues to receive reinforcement (Fisher & Mazur, 1997; Lerman & Iwata, 1995). However, few (if any) investigations have conducted within-subject analyses of the independent effects of both extinction and FCT (i.e., implemented FCT and extinction alone and in combination with the same participant). In the analysis conducted with Amy (Phase 4), extinction, when implemented alone, produced an extinction burst (using the criterion described by Lerman & Iwata, 1995). By contrast, differential reinforcement of communication, whether implemented alone or in combination with extinction, produced immediate and dramatic reductions in destructive behavior and no extinction burst.

The current results appear to contradict previous component analyses of FCT treatment packages, which have often found that reductions in problem behavior were due primarily to extinction or punishment rather than to reinforcement of communication (Fisher et al., 1993; Hagopian et al., 1998; Shirley et al., 1997; Wacker et al., 1990). A notable exception was an investigation by Horner and Day (1991), in which FCT competed effectively with concurrent reinforcement of problem behavior when the communication response was less effortful or was associated with more frequent or more immediate reinforcement. In addition, FCT alone can sometimes sustain reductions in problem behavior previously produced by FCT in combination with extinction or punishment (Fisher et al., 1993; Shirley et al., 1997). That is, once the FCT response and its relation to reinforcement are well learned, communication may remain high and problem behavior low when both responses produce reinforcement on equivalent schedules. Therefore, when evaluating research on the effects of FCT, it may be important to consider when and how the communication response was taught and how easily it was acquired. In most investigations, the communication response is taught prior to evaluating the effects of FCT, and the contingencies in effect for problem behavior during communication training (e.g., blocking, extinction) may help to produce the initial reductions in problem behavior (Shirley et al., 1997).

For Amy, communication training consisted of a brief verbal statement specifying the contingency or contingencies in effect for communication. Thereafter, she rarely displayed problem behavior, regardless of whether extinction was in effect or not. In fact, Amy's destructive behavior decreased to zero during the first application of FCT plus EXT during Phase 3 and also during FCT plus ACT without EXT in Phase 4. Thus, in both phases, responding decreased before Amy contacted the absence (Phase 3) or presence (Phase 4) of a reinforcement contingency for destructive behavior. By contrast, Ned required multiple training sessions during which communication was prompted and reinforced and attempts to display destructive behavior were blocked, which may have helped to produce the initial reductions in destructive behavior. Thus, based on the available research data, a tentative hypothesis may be that FCT is most effective in producing the initial reductions in destructive behavior when (a) the communication response is already in the individual's repertoire and (b) the reinforcement contingency for communication can be easily taught via verbal instruction. For individuals who re-

quire more intensive and extended training to learn the communication response and its relation to reinforcement, it may be necessary to combine FCT with other operant procedures (e.g., extinction, blocking, punishment) to produce the initial reductions in problem behavior. Otherwise, the individual may revert to destructive behavior when communication does not produce reinforcement immediately, consistently, and easily.

In summary, there appear to be a number of advantages of combining discrimination training with FCT. It allows one to incorporate recent advances involving the use of alternative reinforcers when a given reinforcer is unavailable (Fischer et al., 1997; Hanley, Piazza, & Fisher, 1997). The delivery of alternative reinforcement (e.g., toys) may help to mitigate the effects of deprivation resulting from the reinforcer that is unavailable (e.g., attention). The presence or absence of the S^D signals the availability of the various reinforcers at a given point in time. Finally, this approach to treatment provides both the caregiver and the client with some degree of control over the delivery of reinforcement. The caregiver determines what reinforcers are available in a given context, and the client determines when and how often those consequences are delivered.

REFERENCES

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems though functional communication training. *Journal of Applied Behavior Analysis, 18,* 111–126.

Durand, V. M., & Carr, E. G. (1991). Functional communication training to reduce challenging behavior: Maintenance and application in new settings. *Journal of Applied Behavior Analysis, 24,* 251–264.

Fischer, S., Iwata, B. A., & Mazaleski, J. L. (1997). Noncontingent delivery of arbitrary reinforcers as treatment for self-injurious behavior. *Journal of Applied Behavior Analysis, 30,* 239–249.

Fisher, W. W., & Mazur, J. E. (1997). Basic and applied research on choice responding. *Journal of Applied Behavior Analysis, 30,* 387–410.

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.

Fisher, W., Piazza, C., Cataldo, M., Harrel, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinction and punishment. *Journal of Applied Behavior Analysis, 26,* 23–36.

Fisher, W. W., Thompson, R. H., Bowman, L. G., Hagopian, L. P., & Krug, A. (in press). Facilitating tolerance of delayed reinforcement during functional communication training. *Behavior Modification.*

Flora, S. R. (1995). Molar and molecular contingencies and effects of punishment in a human self-control paradigm. *The Psychological Record, 45,* 261–281.

Grosch, J., & Neuringer, A. (1981). Self-control in pigeons under the Mischel paradigm. *Journal of the Experimental Analysis of Behavior, 35,* 3–21.

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 cases. *Journal of Applied Behavior Analysis, 31,* 211–235.

Hanley, G. P., Piazza, C. C., & Fisher, W. W. (1997). Noncontingent presentation of attention and substitute stimuli in the treatment of attention-maintained destructive behavior. *Journal of Applied Behavior Analysis, 30,* 229–237.

Hanley, G. P., Piazza, C. C., Fisher, W. W., Contrucci, S. A., & Maglieri, K. A. (1997). Evaluation of client preference for function-based treatment packages. *Journal of Applied Behavior Analysis, 30,* 459–473.

Horner, R. H., & Day, H. M. (1991). The effects of response efficiency on functionally equivalent competing behaviors. *Journal of Applied Behavior Analysis, 24,* 719–732.

Horner, R. H., Day, H. M., Sprague, J. R., O'Brien, M., & Heathfield, L. T. (1991). Interspersed requests: A nonaversive procedure for reducing aggression and self-injury during instruction. *Journal of Applied Behavior Analysis, 24,* 265–268.

Iwata, B. A., Dorsey, M., Slifer, K., Bauman, K., & Richman, G. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., Rodgers, T. A., Lerman, D. C., Shore, B. A., Mazaleski, J. L., Goh, H., Cowdery, G. E., Kalsher, M. J., McCosh, K. C., & Willis, K. D. (1994). The functions of self-injurious behavior: An experimental-

epidemiological analysis. *Journal of Applied Behavior Analysis, 27,* 215–240.
Kahng, S., Iwata, B. A., DeLeon, I. G., & Worsdell, A. S. (1997). Evaluation of the "control over reinforcement" component in functional communication training. *Journal of Applied Behavior Analysis, 30,* 267–277.
Lalli, J. S., Casey, S., & Kates, K. (1995). Reducing escape behavior and increasing task completion with functional communication training, extinction, and response chaining. *Journal of Applied Behavior Analysis, 28,* 261–268.
Lattal, K. A. (1984). Signal functions in delayed reinforcement. *Journal of the Experimental Analysis of Behavior, 42,* 239–253.
Lerman, D. C., & Iwata, B. A. (1995). Prevalence of the extinction burst and its attenuation during treatment. *Journal of Applied Behavior Analysis, 28,* 93–94.
Mazur, J. E., & Logue, A. W. (1978). Choice in a "self-control" paradigm: Effects of a fading procedure. *Journal of the Experimental Analysis of Behavior, 30,* 11–17.
Mischel, W., Ebbesen, E. G., & Zeiss, A. R. (1972). Cognitive and attentional mechanisms in delay of gratification. *Journal of Personality and Social Psychology, 21,* 204–218.
Richards, R. W. (1981). A comparison of signaled and unsignaled delay of reinforcement. *Journal of the Experimental Analysis of Behavior, 35,* 145–152.
Ross, J. A. (1974). The use of contingency contracting in controlling adult nailbiting. *Journal of Behavior Therapy and Experimental Psychiatry, 5,* 105–106.
Schaal, D. W., & Branch, M. N. (1990). Responding of pigeons under variable-interval schedules of signaled-delayed reinforcement: Effects of delay-signal duration. *Journal of the Experimental Analysis of Behavior, 53,* 103–121.
Schweitzer, J. B., & Sulzer-Azaroff, B. (1988). Self-control: Teaching tolerance for delay in impulsive children. *Journal of the Experimental Analysis of Behavior, 50,* 173–186.
Shirley, M. J., Iwata, B. A., Kahng, S., Mazaleski, J. L., & Lerman, D. C. (1997). Does functional communication training compete with ongoing contingencies of reinforcement? An analysis during response acquisition and maintenance. *Journal of Applied Behavior Analysis, 30,* 93–104.
Wacker, D. P., Steege, M. W., Northup, J., Sasso, G., Berg, W., Reimers, T., Cooper, L., Cigrand, K., & Donn, L. (1990). A component analysis of functional communication training across three topographies of severe behavior problems. *Journal of Applied Behavior Analysis, 23,* 417–429.

Received November 17, 1997
Initial editorial decision January 22, 1998
Final acceptance June 16, 1998
Action Editor, Timothy R. Vollmer

STUDY QUESTIONS

1. What are some potential limitations of functional communication training (FCT), and how did the authors address these limitations in the present study?

2. What communications were taught to the participants, and how was communication scored as correct or incorrect?

3. What modified functional analysis conditions were implemented to assess Amy's problem behavior, and under which conditions did problem behavior occur?

4. Briefly describe the procedures used in the communication and discrimination training phase (Phase 2).

5. What was the difference between the FCT and ACT conditions?

6. What results were obtained during the FCT and ACT conditions for destructive behavior and for correct and incorrect communicative responses?

7. What data speak to the stimulus control aspect of the study?

8. What were some limitations of the comparison between FCT and EXT (Phase 4)?

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